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OUTBREAKS OF *Stomoxys calcitrans* L. ("DOG FLIES") ALONG FLORIDA'S NORTHWEST COAST

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An entomological problem associated with one portion of Florida's extensive coastal area arises as a result of severe annual outbreaks of the blood-sucking fly *Stomoxys calcitrans* L., commonly known as the "stable fly", "biting house fly", or, locally, as the "dog fly". The area concerned is the 200-mile section of

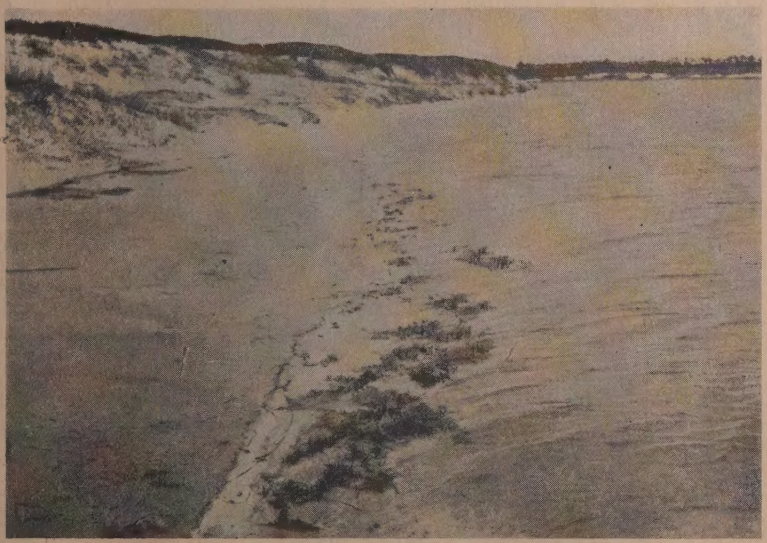

Fig. 1.—A fresh accumulation of *Sargassum* becoming stranded at the edge of Last Resort Lake, Bay County, Fla. View looking inland. (July 25, 1935.)

Gulf coast forming the southern boundary of the western arm of the State and extending approximately from Carrabelle on the east to Pensacola Beach on the west.

In this area swarms of flies begin to appear, as a rule, during the latter part of August or first part of September, and nearly every year parts of this coast become infested. Some years enormous numbers of flies are found along the whole section. During the periods of prevalence, the activity of the flies fluctuates markedly from day to day and, according to statements of the residents, the greatest swarms are encountered when the wind is from a northerly direction. It is reported that the flies appear along the beach at times in such numbers as to cover practically everything, even the bare sand. The beaches are necessarily abandoned by the bathers and vacationists, and many of the bathing resorts are compelled to close during the dog-fly season, which may last for 2 months or more. Fishermen are also greatly plagued by the flies, and the sudden appearance of the pest many miles from shore is said to be a common occurrence.

Livestock, especially cattle, suffer intensely from the attacks of the flies. When these are abundant, the cattle are to be seen during the day standing partially submerged for hours at a time in the salt water of the bays and gulf. Considerable money is spent each year for fly sprays and screening as protection for the dairy stock. Reduction in milk returns during the fly season, in addition to direct expenses, was estimated by various dairy owners at from 20 to 50 percent.

From inquiries among stockmen, flies from the coast apparently migrate inland for 10 to 15 miles, or possibly as much as 25 miles in the worst seasons. Back from the beach itself the flies are much less troublesome to the human host.

This fly is a widely distributed species and is an important pest of livestock in many countries. Serious outbreaks have been reported from inland regions, although these have never been of a regularly recurring nature and seldom approach the magnitude of those occurring on the Florida coast. Outbreaks in Texas and other places have been brought on by the development of large numbers of larvae in stacks of fermenting straw. The normal breeding places are manure piles, so the habits of *Stomoxys* are somewhat similar in this respect to those of the house fly. The larvae have also been taken in piles of lawn clippings.

Few records are available of the breeding of this species in other materials. W. C. Nettles in South Carolina (Jour. Econ. Ent. 27: 1197-1198, 1934) reported prolific breeding in the trickling filters of a sewage disposal plant. The flies have not otherwise been found breeding in human faeces. W. E. Dove, in a personal communication, reported the emergence of adult *Stomoxys* into several sand-fly traps that had been placed on a salt-marsh area near Charleston, S. C. The vegetation here consisted of a stunted growth of marsh grass and the soil had an unusual sourish odor. *Stomoxys* adults were not taken in similar traps in many other locations and it seems improbable that breeding in marsh areas is of common occurrence.

In undertaking an investigation of the problem in northwestern Florida, it was evident that search should be made for breeding conditions peculiar to this section of coast and of a seasonal nature. Straw stacks were found to be almost nonexistent in the area and there seemed to be nothing unusual about the handling or the amount of stable manure, so these could be eliminated immediately from special consideration.

On a preliminary visit to the area in October 1933, large piles and windrows of seaweed were noted around the shores of the numerous bays that indent the coast line. The accumulations consisted mostly of the common wide-bladed turtle grass, *Thalassia testudium,* and the narrow-bladed manatee grass, *Halodule wrightii.*[1] The piles showed varying degrees of dampness and decay, and while they were suspected on first sight of being a suitable breeding medium, no *Stomoxys* larvae could be found in this material either on this or subsequent occasions. Other considerations that would tend to rule out the possibility of their connection with the present problem are the facts that the piles are present the year round and similar accumulations are to be found in many other coastal sections.

There are considerable areas of low salt marsh land around the bays and, in view of the observations reported by Dove, the possibility of fly breeding in these marshes was also investigated. The soil was found to be largely of a soft mucky character with a growth of black rush, or spike grass, *Juncus* sp. In places, fairly large quantities of dead and decaying stems had been accumulated by the action of waves and tides. During many

[1]The identification of these plants was obtained through Mr. Erdman West of the University of Florida.

hours of intense searching, however, no larvae were to be found in the muck or the decaying rush, and no emerging adults were obtained in a series of flytraps placed on the marshes.

Before this line of search was suspended, encouragement to the efforts was given by an interesting observation on oviposition to which attention was called by one of the local residents, Mr. W. C. Holley, at South Port. Mr. Holley reported that he frequently had seen dog flies, sometimes by the hundreds, settling on moist soil in certain places, apparently to deposit eggs or larvae. Upon visiting one of these places, the senior author was able on several occasions to confirm the observation. The females were seen to alight on the soil, extend the tip of the ovipositor under a small root or lump of dirt, and proceed to deposit a few eggs in each of several spots. The location was a gently sloping and partially wooded side hill just above a small tidal flat, with black humus soil kept moistened by a fresh-water seepage outcrop. This unusual occurrence was carefully followed up but no evidence at all was obtained that larvae were developing or could develop in such material.

A definite lead was finally obtained, in September 1934, upon revisiting one of the beach resorts that was reported as being unusually badly infested with flies. Here eggs and larvae were first found on some sandy soil that was kept moist and foul by the drippings from a sink in which fish were cleaned. Upon being shown some of the larvae, one of the colored helpers stated that he had seen many maggots of a similar appearance at the edge of a nearby salt-water lake known as Philips Inlet. This proved to be the clue needed, for numbers of *Stomoxys* larvae and pupae were soon located in a certain kind of seaweed, *Sargassum,* accumulated in small piles just at the edge of the water. Breeding was also found shortly afterwards in more limited accumulations of the same seaweed in wet swales, or depressions, along the Gulf beach. In places of both types the lower part of the piles, where the larvae occurred, was saturated with the salt water. The pupae were located in drier parts of the tangled mass of plants. The water in the lake at the time of the observation showed a specific gravity of 1.016 at 76°F., corresponding to a salt content of about 2.5 percent. The water in the swales was not tested but was probably even saltier than this. In some of the places where breeding was found, the plants were mixed with fish refuse, but this did not appear to be a constant factor.

Samples of the seaweeds were identified by Mr. West as two species of *Sargassum,* probably *filipendula* and *pteropleuron.* These belong to the higher brown marine algae and have branched stems with definite leaves. The branches also bear numerous small berry-like air vessels, or float organs. The plants are greenish when fresh and become dark brown or almost black when dry. Windrows of the dried and shriveled plants are common along the beaches but are unfit for fly breeding in the dry state. *Sargassum* is known locally by various names, such as "berry grass" or "ball grass", "May grass", and "rock grass", the last name referring to its supposed origin on submarine rock beds. It is also known more generally as "Gulf weed". The generic name is a familiar one because of the famous Sargasso Sea from which the name is taken, where great areas are covered by the floating plants.

The writers are not familiar with the habits of *Sargassum* except that the plants are to be seen floating in the water along the Florida coasts at times during the spring or summer. In 1935, they were noted in abundance at Daytona and Miami Beach on the Atlantic coast in March. Samples from the former place were identified as *S. pteropleuron.* The northwest coast was visited in July and considerable quantities of recently stranded

Fig. 2.—A closer view of the marine algae, *Sargassum.*

Sargassum (identified as probably *S. fluitans*) were observed by the senior author along the beach near Philips Inlet, although very few plants were floating in the surf. The passage from Philips Inlet was open at this time and the passage from Last Resort Lake had been open a day or so before. Some of the weeds were stranded at the edge of the water in the lower parts of the lakes (Figs. 1 and 2), and apparently were the first of the season to enter. Fly breeding had not yet started in them. The fresh plants were said to have been brought to the shore by a storm a few days previously. They were reported as having been abundant in the surf along the same shore about a month earlier. The drifting weed evidently does not accumulate in the open bays in that section, as few plants could be found on the bay shores.

While *Sargassum* is by no means peculiar to the northwest Florida coast, its coincidence with certain physical features of this section may explain the localization of the *Stomoxys* outbreaks. In the stretch of Gulf coast west of St. Andrews Bay are several small lakes similar to the large one, Philips Inlet, where breeding was first found. These lakes lie directly back of or among the sand dunes, with outlets cut through the dunes

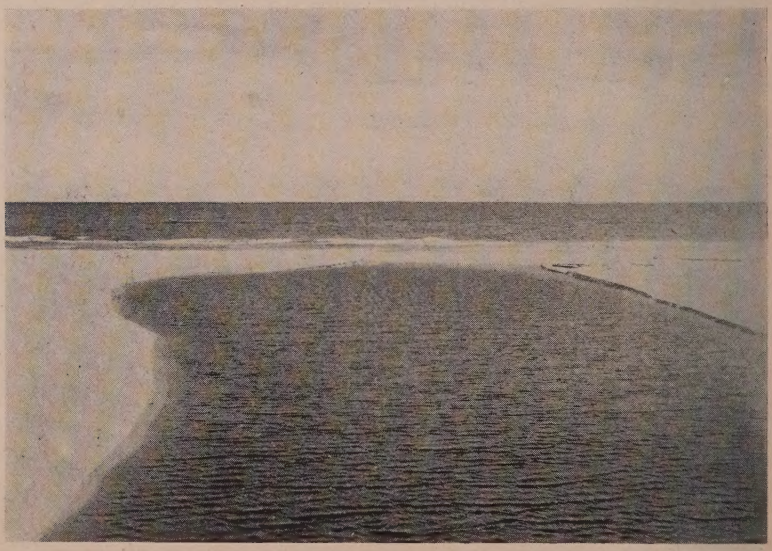

Fig. 3.—The passage from Last Resort Lake into the Gulf. The passage is partially closed with a sand barrier after having been washed open by high water.

and beach to the gulf. While these channels are usually closed with sand thrown up by wave action (Fig. 3), they are washed open on occasions by storm tides or by overflowing water from heavy rainfall. If *Sargassum* is present in the surf at such times it is carried into the lakes on high tides and some of it becomes stranded just at the water line when the lake level drops to normal. Closing of the passage again by sand prevents further tidal fluctuations, which otherwise would tend to strand the material so high on the bank that it would become dry. Such semi-isolated saline lakes are not known to the writers on other parts of the Florida coast.

Since the finding of *Stomoxys* breeding in *Sargassum,* the writers have not been able to continue the observations on other portions of the affected coast. We are, however, under the impression that lakes similar to those mentioned are rare west of Choctawhatchee Bay. It is entirely possible, therefore, that other conditions enter into the problem. Nevertheless, breeding appears to be comparatively concentrated in the area where the studies were made and the elimination of the breeding material as it accumulates here may prove to be a feasible and effective operation in the control of the insect.[2]

[2]The writers are indebted to L. C. Merriam, C. A. Barnes, and other local residents for their assistance in connection with the investigation.

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RECORDS OF FLORIDA DRAGONFLIES—II*

By C. FRANCIS BYERS

In 1929, the author (Byers '30) finished writing an account of the Dragonflies of Florida which contained all of the pertinent information on that subject known to the writer at the time. In the fall of 1934 (Byers '34), an additional set of records was published. During the year 1935, several new and important records have turned up and two old ones have been brought to the attention of the writer. It is the purpose of this paper to record these new additions. Only those records are listed that are pertinent to an understanding of the occurrence, distribution and life-histories of dragonflies in Florida. The new additions are as follows:

PART I.

*1. **Dromogomphus armatus** Selys. Northeastern Florida, July, 1935 (1). Originally described and previously recorded from Georgia only. The Florida specimen was recovered from the radiator of an automobile driven from Jacksonville to Gainesville; the body was still soft.

2. **Dromogomphus spinosus** Selys. Alachua County, High Springs, July 1935, (1). This specimen, in a semi-teneral condition, was collected from low vegetation near the banks of the Santa Fe River. It is the first adult specimen of *D. spinosus* that the writer has seen from Florida. In April 1931, a nymph was received from Collin's Mills, near Milton, Florida, belonging to this genus, but of which species is not known.

3. **Didymops floridensis** Davis. Bradford County, Starke, April 10, 1936, (1). Taken, in almost perfect condition and still alive, from the

*Contribution of the Department of Biology, University of Florida.

radiator of an automobile driven on State Highway No. 48 from Kingsley Lake to Starke. Mr. W. T. Davis (Davis '21) described *D. floridensis* from two male specimens taken at Lakeland, Florida, March 28, 1912. No other material has been reported since Mr. Davis' paper was published in 1921. This record, therefore, is of special interest because it is the first one for the female of the species. The taxonomic characters listed by Mr. Davis as distinct for *D. floridensis* apply to the female as well as to the male. The anal appendages of the female of *floridensis* are broader and possess a shorter terminal spine than do those of *D. transveras*, otherwise the genitalia of the two species are the same.

*4. **Neurocordulia virginiensis** Davis. Jackson County, Chipola River, April 1935, (1). Collected by R. E. Bellamy who writes that it was taken, "Along low wooded and slightly marshy region east of the Chipola River above the Tallahassee-Marianna road. In afternoon—still—very cold." This record is of special interest not only because it is the first one for this species from Florida but also because it is the first record of the collecting of the male of the species. Mr. W. T. Davis (Davis '27) described *N. virginiensis* from a single female collected in Virginia. No other material has been reported until Mr. Bellamy's find in April 1935. Nymphs of *Neurocordulia* sp.? have been frequently collected in western and central Florida, especially in the Santa Fe and the Chipola River drainage systems (Byers '30). Description and notes are being written by the author.

5. **Brachymesia gravida** (Calvert). Alachua County, Newnan's Lake, Gainesville, May 1935, (4). The four females recorded here were taken emerging, thus giving us our first exact knowledge of the nymph of this species. Description and notes have been published by the writer, (Byers '36).

6. **Sympetrum corruptum** Hagen. Orange County, Winter Park, November 1934, (1). Collected by Mr. E. M. Davis. A southern extension of the range of this northern dragonfly, which has previously been recorded in Florida from Alachua County only.

7. **Pantala hymenea** (Say). Monroe County, Cape Sable, February 1935, (4 nymphs). Taken in a cistern of brackish water near Palmetto, Florida. Mr. E. M. Davis reports having received adults from Florida. *Pantala flavescens* (Fabricius) occurs commonly in Florida, is, in fact, one of the dominant fall species. *P. hymenea* and *P. flavescens* have been collected by the writer in South Carolina flying together. Why *P. hymenea* is so comparatively rare in Florida is an interesting question.

8. **Ischnura kellicotti** Williamson. Orange County, Winter Park, May 1934. Collected by Mr. E. M. Davis. A southern extension of the range of this species, which is beginning to make its appearance in central Florida as a fairly common form.

PART II.

In this portion of the list are given records taken from literature or from letters addressed to the writer. The author has not seen the specimens indicated.

9. **Libellula jesseana** Williamson. Orange County, Winter Park. Mr. E. M. Davis writes, "A very evident *L. jesseana* was brought to me the other day (circa April 18, 1935) from the east shore of Lake Apopka. It is apparently an old one". Mr. Davis later collected quite a series of this species from the same locality. The Williamson type material (44 ♂ ; 2 ♀) was taken near Enterprise, Florida (Williamson '22); the author has one male taken near Orlando in 1924. So the species has evidently established and maintained itself in the territory over the last fifteen years (Byers '30, p. 263).

*10. **Sympetrum ambiguum** (Rambur). On a library card, recently found in my files, there is written the following note by the late E. B. Williamson, "In one of large boxes of pinned *Sym. rubicundulum* in museum (University of Michigan) collection is a *Sym. ambiguum* (labeled) 'Alachua Co., Fla., Gainesville, 11-20-22. H. Graves, Coll.' "

*11. **Miathyria marcella** (Selys). Dr. James G. Needham (Needham '33) records the collection of a nymph of this species about midway between Fort Pierce and Okeechobee, Florida, in a roadside ditch created by the construction of State Highway No. 8. In a letter to the writer dated October 13, 1934, Dr. Needham remarks that he has also received the adult from another collector. This is not only a new state record but also, as Dr. Needham points out, a new record for the United States. The range of *M. marcella* is usually given: Mexico to Argentina and the Greater Antilles.

The species added to the Florida list in the foregoing (*) bring the total number of species occurring, or said to occur, within the State to 131.

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THE LARGE-WINGED MITES OF FLORIDA

ARTHUR PAUL JACOT

(Continued from page 31)

In determining the commonest species, the frequency of occurrence, that is the number of lots in which a species occurs, is used instead of the number of individuals because these animals tend to be colonial. For instance one lot has 115 individuals of one species. This also is in accord with experience in other groups. The commonest species are *Zetes elimatus louisianae, Galumna flagelliferum, G. curvum,* and *Z. weberi,* then follow, in order of frequency, *Z. minutus, Holokalumma coloradensis, Parakalumma robustum.* The others are local. Thus there is no outstandingly abundant species as in the Phthiracaridae (11). Zetes has by far the largest number of species —in the litter.

Of the forty-three lots, only thirteen yield three or more species. Lot G75, which was a rich lot for Phthiracarids, contains the largest number of species of Galumninae (seven), namely, *Protokalumma depressum, Parakalumma robustum, Zetes elimatus louisianae, Z. minutus, Holokalumma coloradensis, Galumna flagelliferum,* and *G. curvum.* Lot G115 (Wellborn) yielded the same species except that *Z. weberi* replaces *Z. elimatus,* and *P. depressum* is absent. *P. robustum* drops out to the southward.

By contrast, nine species (five of them found about Gainesville) have been taken from one *locality* in Connecticut.

Sixteen lots secured by Prof. J. R. Watson between December 1928 and March 1930, chiefly from the Gainesville region give the following occurrences:

	P. robustum	11 (4)	and two indiv. from Crystal R.
	P. robustum floridanum	1 (1)	
	Z. elimatus louisianae	4 (3)	and one indiv. from Royal Palm
	Z. emarginatus	1 (1)	and three from Worthington
18.	*Z. banksi*	1 (1)	and two other collectors!
	H. coloradensis	3 (2)	
19.	*G. lanceatum octopunctatum*	31 (5)	
	G. flagelliferum	4 (3)	

It is interesting to note how these few additional lots yield two new records to the state list, even though 27 lots had already been secured from this locality (Gainesville region). This is

due to collecting from different niches, as on tree trunks and tree boles.

Finally, the twentieth species *Holokalumma floridae* was obtained from Cocoa, and the twenty-first *Zetes bradleyi* from near Tarpon Springs.

ECOLOGICAL DATA

None of the more severe habitats harbored Galumninae, thus they are not as resistant as *Pseudotritia ardua*. There seems to be some habitat preference. For example *Zetes weberi* is associated with fallen live oak leaves and also long-leaf pine. As usual, dry pine and spruce litter is rather barren, except that *H. lyricum*, the longest bristled species, was found in this habitat. *Z. elimatus louisianae* and *Holokalumma coloradensis* seem to prefer drier habitats. *G. curvum* was found on a magnolia tree bole, so that again it shows a tendency to ascend vegetation. On the whole the species of this subfamily are more abundant on oak and long-leaf pine land. In one case (lot G67) shore bay debris yielded five species.

Protokalumma depressum x *pterotum*, only found in the horticultural grounds at Gainesville, is either a recent introduction or the offspring of two individuals introduced with plants. I have noted no other such hybrids from further north where both species occupy the same territory.

Collections from other habitats may yield other species. Compare Watson's lots with Grossman's.

GEOGRAPHICAL DISTRIBUTION

The distribution of the different species may be visualized by means of the following table:

1. *Protokalumma depressum* x	Gainesville, hort. grounds
2. *Parakalumma robustum*	w. Fla. to Tarpon Springs and White City
3. *P. robustum floridanum*	n. peninsular
4. *Zetes macroptera matecumbei*	Key Largo, Lower Matecumbe
5. *Z. elegantulus*	Bradenton, Dunedin
6. *Z. bradleyi*	near Tarpon Springs
7. *Z. emarginatus*	n. Fla.
8. *Z. emarginatus laevis*	n. Fla.
9. *Z. elimatus louisianae*	peninsular, except s. tip
10. *Z. weberi*	all Fla.
11. *Z. weberi plumalae*	Astor, Mulberry
12. *Z. minutus*	w. Fla. to Vero Beach
13. *Z. banksi*	Gainesville (probably n. Fla.)

14. *Holokalumma coloradensis* ..... w. Fla. to Vero Beach and Miami
15. *H. lyricum* ..... Campville, Tarpon Springs
16. *H. floridae* ..... Cocoa
17. *Galumna lanceatum octopunctatum* Gainesville
18. *G. alatum hispidum* ..... Fort White, Gainesville
19. *G. curvum* ..... peninsular, s. to Fort Lauderdale
20. *G. flagelliferum* ..... peninsular
21. *G. flagelliferum circulum* ..... Cortez, Vero Beach, Miami

This distribution contrasts markedly with that of the Phthiracaridae (11). There are some very much localized species. All of the species, as far as can be judged from the present data, have come in from the north and west and spread chiefly down the east coast. For instance *Z. minutus* and *H. coloradensis* are not yet reported from the west coast. This was also the case with the abundant and ubiquitous *Pseudotritia ardua sinensis*. Thus, as in the Phthiracaridae, the chief element governing distribution within the state, seems to be physiographic.

To further check up on this factor, an analysis of the distribution of the passerine birds of Florida was made (8). The passerine birds were chosen as better known and less interfered with by man. Two distinct types of distribution were found: (1) tension zone of two subspecies, (2) southern limit of northern birds.

A species occupying the whole state often breaks into two subspecies between the Apalachicola and the Aucilla rivers. The Pine-woods Sparrow, Towhee, Cardinal and Crow stop at the Aucilla. On the other hand some of the peninsular species follow along the coast to Apalachicola, as the Boat-tailed Grackle, Florida Redwing and Florida Wren.

Northern species range south to the borders of the Lower Austral, that is to the middle of the peninsula. Those which extend to the center of the peninsula are the Acadian Flycatcher, Rough-winged Swallow, Southern Blue Jay, Chickadee, White-breasted Nuthatch, Catbird, Brown Thrasher, Yellow-throated Vireo, Red-eyed Vireo, Prothonotary Warbler, Parula Warbler, Blue Grosbeak, Towhee, Lecont's Sparrow, Henslow's Sparrow, Sharp-tailed Sparrow, Field Sparrow, Swamp Sparrow and Song Sparrow. This distribution is significant because it applies to many of the overwintering sparrows as well as to so many of the nesting birds. This midpeninsular boundary fluctuates with the species but it usually cuts diagonally across from northwest to southeast as in figures 41, 44, 47, 57, 58, and 60 (8). This

is the same avoidance of the west coast, and trend toward the east coast, as was observed in the Galumninae.

At least one botanist (17) divides the peninsula across the center (without mentioning definite boundaries or citing data).

The only clue to this distributional pattern was found in connection with the distribution of craneflies (16, p. 27, last ¶). Reference to the phytogeographic map (17, p. 69) shows the trend of hardwoods to be along northern Florida to the Alapaha branch of the Suwannee River. Here this hardwood belt trends southeastward. A glance at the state soil map (7) also brings out this southeastward trend. The hammock land adjacent to Bradenton also explains the larger number of Oribatoidea found at this locality. Diptera were found to be much more abundant in these hammocks and in the swamp woods than along the coasts (15, p. 39, last ¶).

To summarize: the distribution of certain groups of animals within the state seems to be largely dependent on the trend of vegetation types which in turn are dependent upon physiography and soil types.

The Florida species of Galumninae extend into the following life zones: endemics (at least temporarily): *Parakalumma robustum floridanum, Z. macroptera matecumbei, Zetes elegantulus, Z. bradleyi, Z. emarginatus laevis, Z. weberi, Z. weberi plumalae, Holokalumma lyricum, H. floridae, G. alatum hispidum, G. flagelliferum circulum* (eleven); lower austral: *Z. elimatus louisianae, Z. banksi;* upper austral: *Z. minutus, H. coloradensis, G. flagelliferum* (three); transitional: *Protokalumma depressum, Parakalumma robustum, Z. emarginatus, G. lanceatum octopunctatum, G. curvum* (five).

Eight hundred species of Florida diptera (15), 117 species of Odonata (3), and 128 species of Craneflies of northern Florida (16) were found to have the following life zone ratios:

	Diptera		Odonata		Craneflies
Endemics	15%		17%		19%
Lower austral	12%		.....		.....
Upper austral	35%	67%	42% (Indiana)	77%	69%
Transitional	20%		35% (Conn.)		
Tropical	15%		23%		9%
Mex. and s. Calif.	3%		.....		.....
Cosmopolitan	.....		14%		1.4%

Thus the enormously high ratio of endemic Galumninae seems to be due to lack of knowledge of the distribution of these species in the other southern states.

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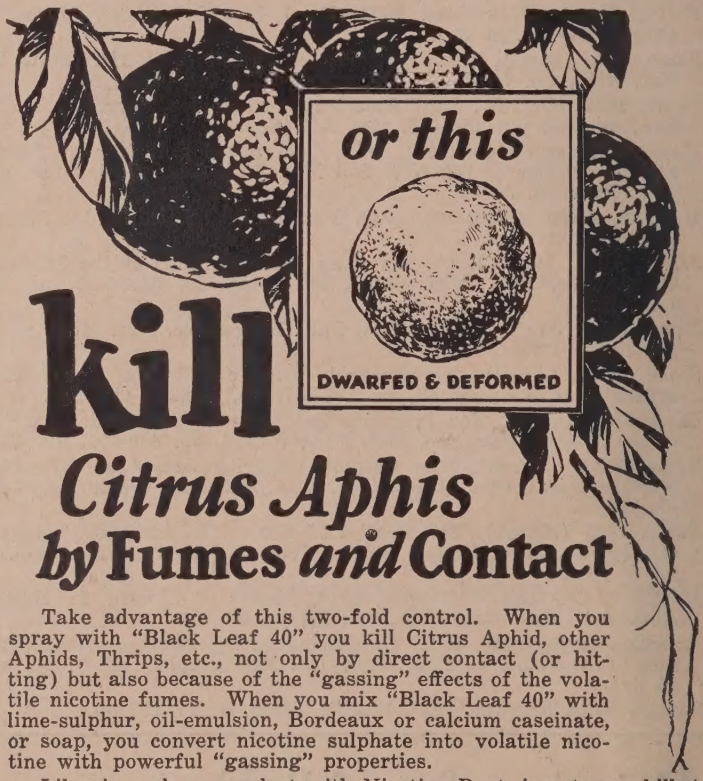

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